(No Model.) 5 Sheets—Sheet 1.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 565,800. Patented Aug. 11, 1896.

Fig. 1

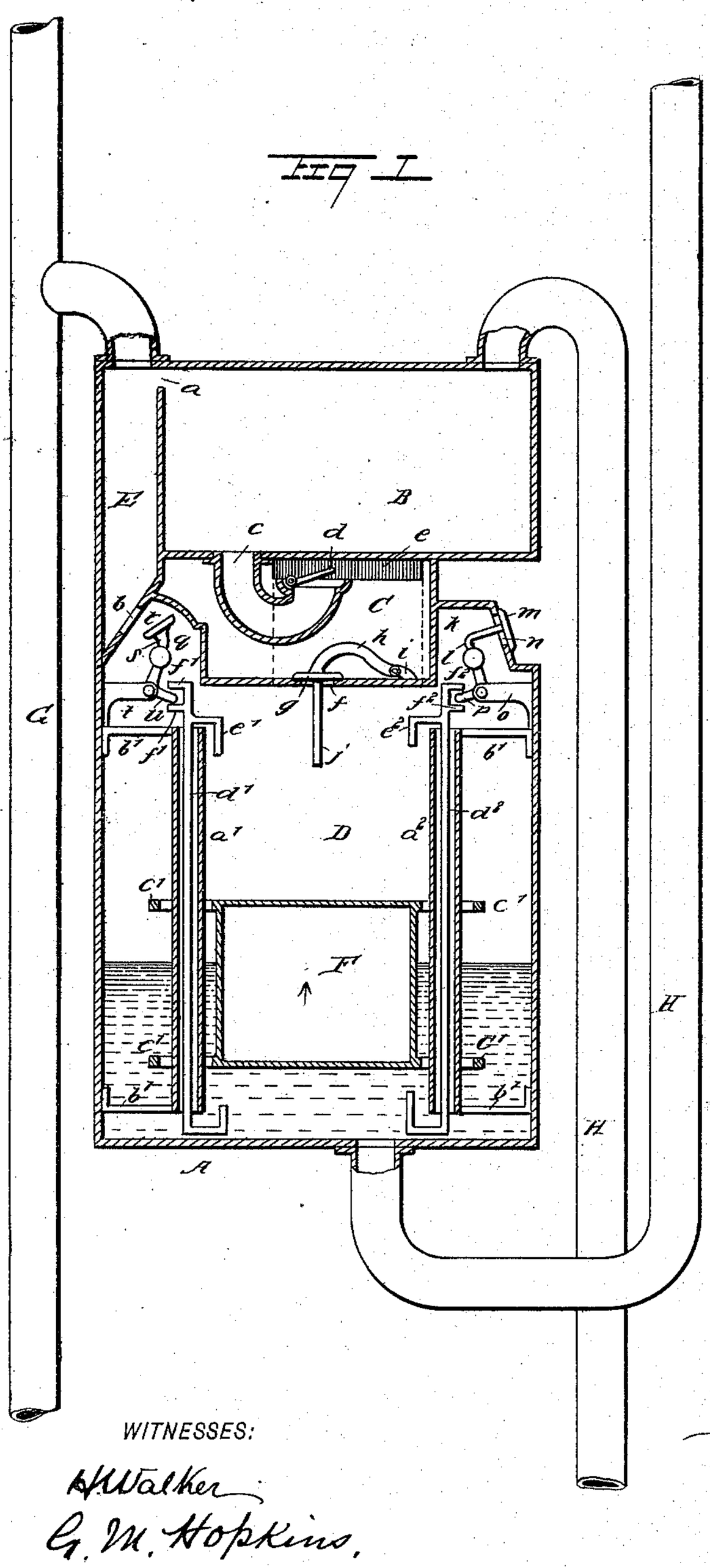
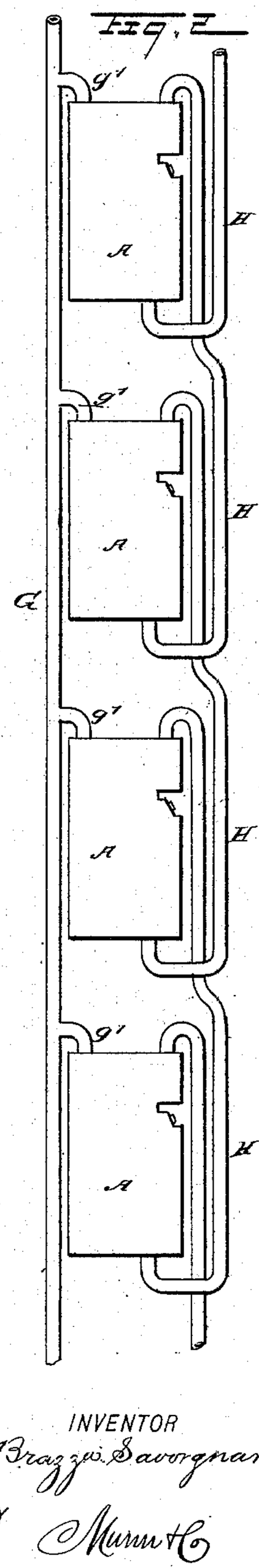


Fig. 2



WITNESSES:

H. H. Walker

G. W. Hopkins.

INVENTOR

D. di Brazza Savorgnan

BY Munn & Co

ATTORNEYS.

(No Model.) 5 Sheets—Sheet 2.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 565,800. Patented Aug. 11, 1896.

Fig 3

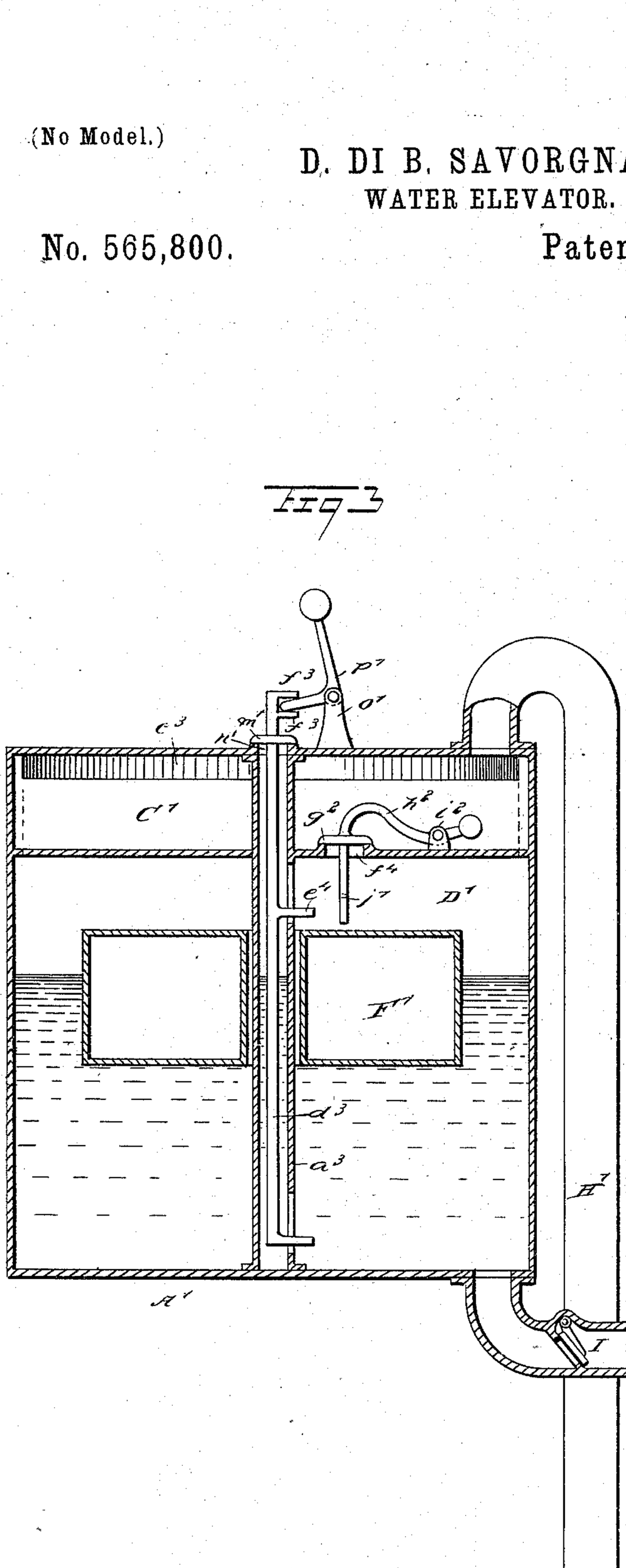
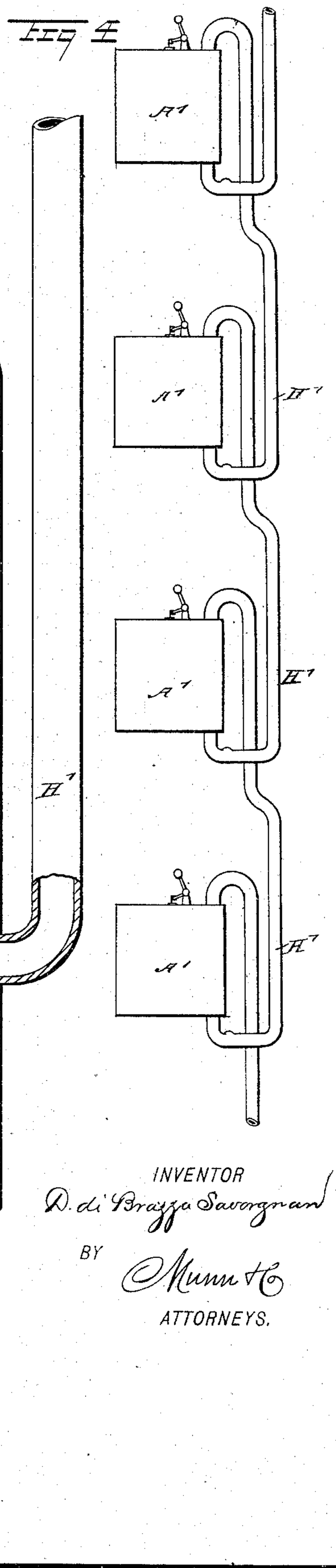


Fig 4



WITNESSES:
H. Walker
G. M. Hopkins.

INVENTOR
D. di Brazza Savorgnan
BY Munn & Co
ATTORNEYS.

(No Model.) 5 Sheets—Sheet 3.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 565,800. Patented Aug. 11, 1896.

Fig 5

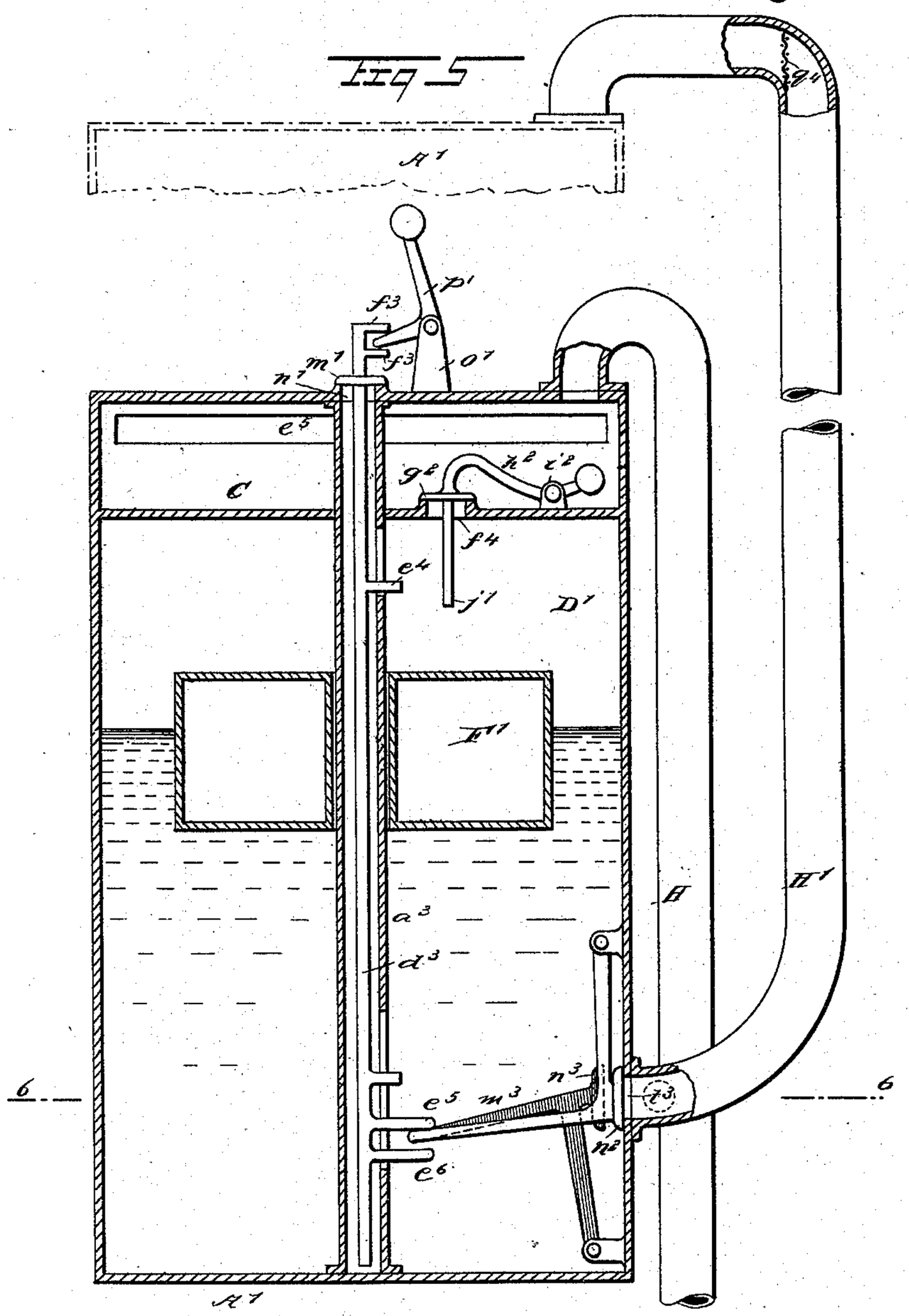
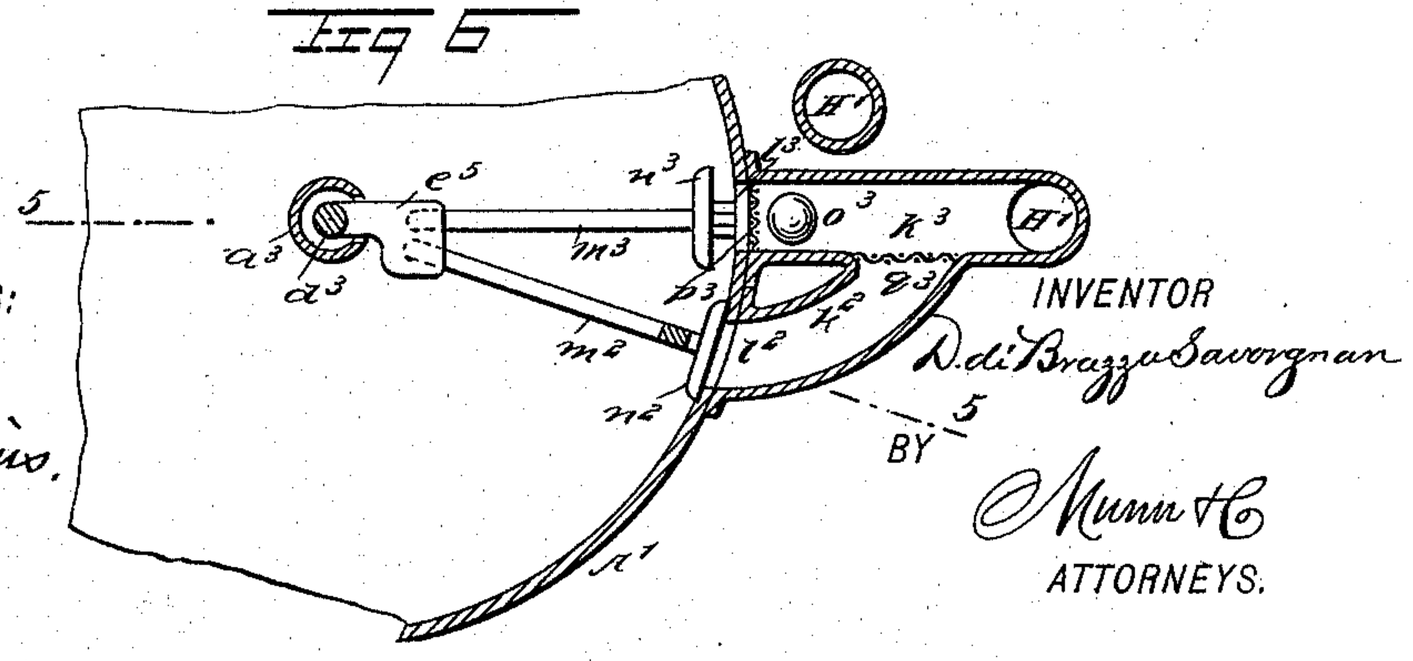


Fig 6



WITNESSES:

H. Walker

G. M. Hopkins.

INVENTOR

D. di Brazza Savorgnan

BY

Munn & Co

ATTORNEYS.

(No Model.) 5 Sheets—Sheet 4.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 565,800. Patented Aug. 11, 1896.

Fig 7

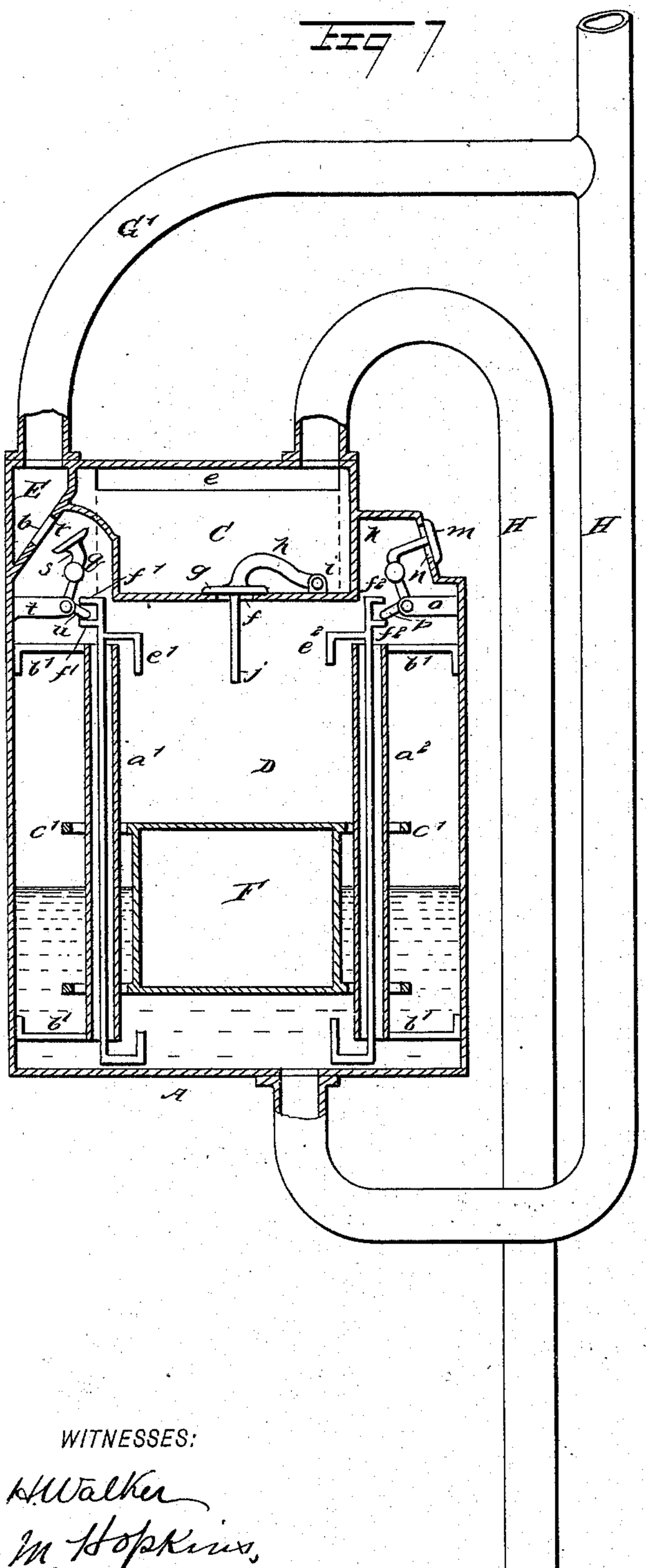
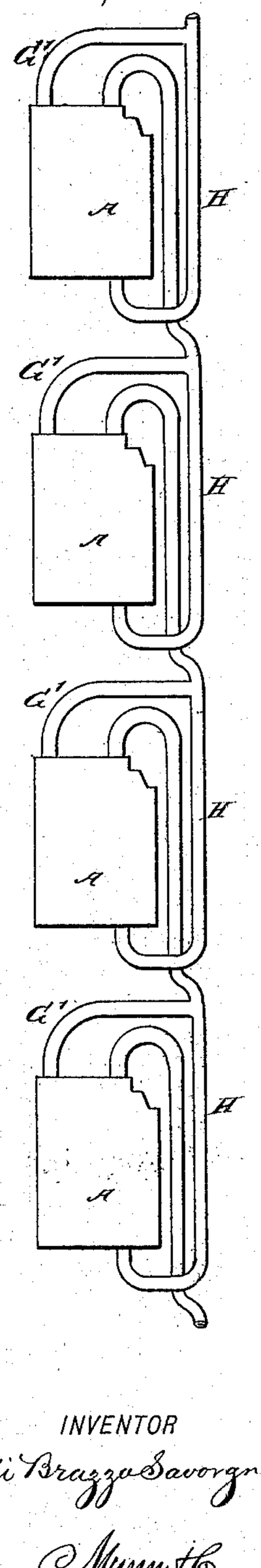


Fig 8



WITNESSES:

H. Walker

G. M. Hopkins,

INVENTOR

D. di Brazza Savorgnan

BY

Munn & Co

ATTORNEYS.

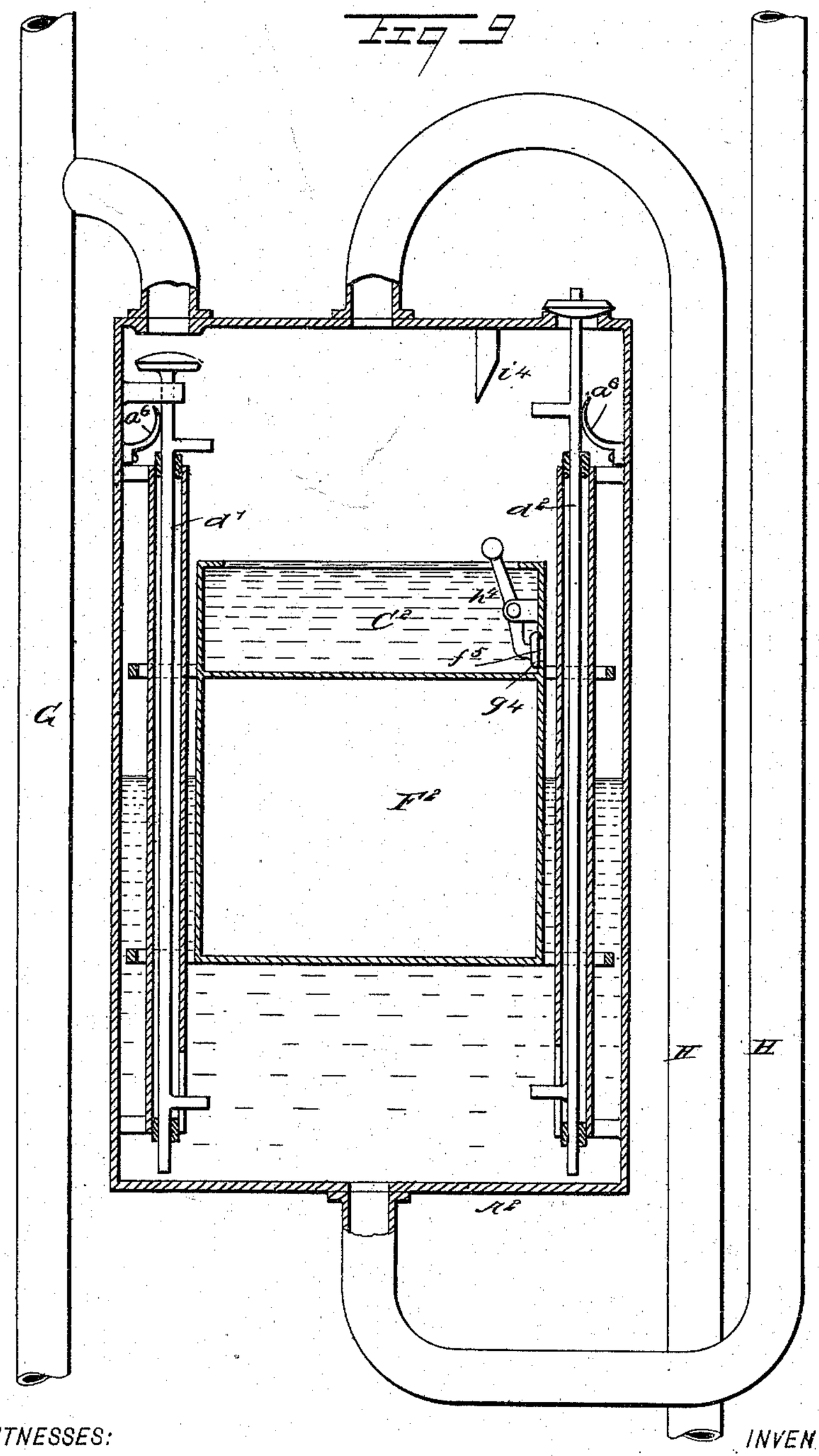
(No Model.) 5 Sheets—Sheet 5.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 565,800. Patented Aug. 11, 1896.

Fig 9



WITNESSES:

H. Walker

C. M. Hopkins.

INVENTOR

D. di Brazza Savorgnan

BY Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

DETALMO DI BRAZZA SAVORGNAN, OF ROME, ITALY, ASSIGNOR TO CORA ANN SLOCOMB DI BRAZZA SAVORGNAN, OF CASTLE DI BRAZZA, MORUZZO, ITALY, AND NEW YORK, N. Y.

WATER-ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 565,800, dated August 11, 1896.

Application filed April 4, 1895. Serial No. 544,461. (No model.)

To all whom it may concern:

Be it known that I, DETALMO DI BRAZZA SAVORGNAN, of Rome, Italy, have invented a new and Improved Water-Elevator, of which the following is a full, clear, and exact description.

The object of my invention is to construct a water-elevator without cylinders, pistons, or piston-rods, for deep wells, mines, and excavations, in which the natural pressure of the atmosphere will be utilized in raising the water.

My invention consists in a series of chambers provided with supply and discharge pipes and valves and a float-operated mechanism for opening and closing the valves, all as will be hereinafter more fully described.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the views.

Figure 1 is a side sectional elevation of one of the water-elevating chambers. Fig. 2 is a side elevation of a series of such chambers connected with each other and with the vacuum-pipe. Fig. 3 is a side sectional elevation of a modified form of vacuum-chamber. Fig. 4 is a side elevation of a series of such chambers connected together. Fig. 5 is a side sectional elevation of another modification on the line 5 5 in Fig. 6. Fig. 6 is a partial horizontal section taken on line 6 6 of Fig. 5. Fig. 7 is a vertical transverse section of another modification. Fig. 8 is a side elevation of a series of such vacuum-chambers, and Fig. 9 is a modification of the form shown in Fig. 1.

The chamber A is divided into three compartments B C D, with a passage E at the side of the chamber communicating directly and continuously with the compartment B through the opening *a*, and communicating through the inclined valve-opening *b* with the compartment D. The compartment B communicates through the short U-shaped pipe *c* with the compartment C, and the upwardly-turned end of the said pipe *c* is furnished with a check-valve *d*, opening upward. In the wall of the compartment C is formed a slot *e*, through which water may overflow into the compartment D, and the compartment C communicates with the compartment D through the valve-opening *f* in the bottom of the compartment. The valve-opening *f* is closed by the valve *g*, which is attached to a curved arm *h*, pivoted between ears *i*, secured to the floor of the compartment C. A stem *j* extends from the valve *g* downward through the valve-opening *f* into the compartment D.

In an upward extension *k* of the compartment D is placed a weighted valve-carrying arm *l*, which is bent at right angles and attached to a valve *m*, adapted to close the valve-opening *n* in the side wall of the upward extension of the chamber D. The angled arm *l* is pivoted in a bracket *o*, extending inwardly from the wall of the compartment D, and the said arm is furnished with a finger *p*, projecting into the compartment D at right angles to the pivoted end of the arm.

In the upward extension *q* of the compartment D, communicating with the valve-opening *b*, is placed a vacuum-valve *r*, which is attached to a curved arm *s*, pivoted in the bracket *t*, projecting from the wall of the compartment D. The arm *s* is provided with a finger *u*, projecting at right angles toward the center of the compartment D. The arms *l* and *s* are provided with weights which serve to hold the said arms and valves attached to them in either an open or closed position.

In opposite sides of the compartment D are supported tubes a' a^2 by brackets b', attached to the wall of the chamber A. The said tubes a' a^2 form guides for the float F. The float F is furnished with ears c', two on either side, the apertures of which are prolonged to permit of the tipping of the float in the operation of the apparatus, as will be hereinafter described. In the tubes a' a^2 are placed the rods d' d^2. The rod d' extends downwardly toward the bottom of the chamber A and is bent twice at right angles, the end of the rod extending upward toward the float F. The upper end of the rod is furnished with an angled arm e', which extends over the top of the tube a' and downward toward the float F, and the upper end of the rod d' is also furnished with two lugs f', which loosely embrace the finger *u* of the valve-arm *s*. In a

similar way the lower end of the rod d^2 extends upwardly toward the float F, and the upper end is furnished with an angled arm e^2, extending downwardly toward the float F and provided with lugs f^2, which embrace the finger p of the valve-arm l.

The chambers A are arranged one above the other in a series, the distance between them being about equal to the distance through which a pump can draw water. The top of each chamber is connected by a curved pipe g' with the vacuum-pipe G, which extends to a suitable vacuum-pump. The bottom of each chamber A is connected by a pipe H with the top of the next chamber above.

In the modification shown in Fig. 3 the chamber A′ is divided into two compartments C′ D′, and the compartment C′ communicates with the compartment D′ through a slot e^3 in the partition which separates the upper portion of the chamber A′ into two compartments. In the chamber A′ is secured a tube a^3, which extends through the compartments C′ D′, but does not communicate with the compartment C′. On the tube a^3 is placed a centrally-apertured float F′, and in the tube a^3 is placed a rod d^3, having its lower end bent at right angles and projecting through a slot in the side of the tube a^3 below the float F′. The rod d^3 is provided with an arm e^4, which projects through a slot in the tube a^3 above the float F′. The upper part of the rod d^3 carries a valve m', which closes an opening n' in the top of the casing, which is coincident with the bore of the tube a^3. The upper end of the rod d^3 is provided with two lugs f^3. In a standard o', projecting from the top of the casing, is pivoted a right-angled lever p', the shorter arm of which extends between the lugs f^3 of the rod d^3, and the longer arm of the said lever carries a weight which swings to one side or the other of the center of movement and holds the lever in either of the two positions in which it may be placed.

In the horizontal partition between the compartments C′ and D′ is formed a valve-opening f^4, which is closed by a valve g^2, attached to a curved arm h^2, pivoted between ears i^2, projecting upwardly from the floor of the compartment. The valve g^2 is furnished with a stem j', which extends downwardly toward the float F′. A pipe H′ communicates between the bottom of one chamber, A′, and the top of the next chamber above in the series, and each pipe H′ near the bottom of the chamber A′ is furnished with a check-valve I, opening upwardly.

In the modification shown in Figs. 5 and 6 the construction is similar to that shown in Fig. 3. Therefore the same letters of reference will apply to like parts. In the said modification the lower portion of the chamber A′ is extended downwardly and the rod d^3 and tube a^3 are extended downwardly, the rod d^3 being provided with a pair of lugs e^5 e^6. The lower end of the pipe H′ in this case is forked and the branches k^2 k^3 communicate with the lower part of the chamber A′ through valve-openings l^2 l^3, which are on the same level. Angled levers m^2 m^3, pivoted in ears projecting inwardly from the side of the casing, carry valves n^2 n^3, adapted to close the valve-openings l^2 l^3. The free ends of the levers m^2 m^3 extend between the lugs e^5 e^6, projecting from the rod d^3, and the levers are oppositely arranged with respect to each other.

In the branch k^3 of the pipe H′ is placed a ball o^3, which is slightly heavier than water, and the mouth of the branch k^3, opening into the chamber A′, is provided with a wire-cloth guard p^3. The branch k^2 of the pipe H′ at its juncture with the said pipe is provided with a wire-cloth guard q^3 for preventing the ball o^3 from entering the said branch, and the upper end of the pipe H′ is provided with a similar guard q^4 for preventing the ball from going into the next chamber above.

The modification shown in Figs. 7 and 8 differs from the form shown in Fig. 1 in the omission of the compartment B, the U-shaped pipe c, the valve d, and pipe G, and in connecting the passage E with the pipe H by the pipe G′.

In the modification shown in Fig. 9 a water-receiver C^2 is formed on the top of the float F^2, and a valve-opening f^5 is formed in the side of the water-receiver and closed by a valve g^4, carried by the valve-lever h^4, pivoted to an arm projecting inward from the wall of the water-receiver. The upper arm of the valve-lever h^4 is inclined away from the wall of the water-receiver and provided with a weight which tends to keep the valve g^4 closed. An inclined plane i^4 projects downward from the top of the chamber A^2 in the path of the lever h^4, so that when the float carries the said lever up into engagement with the inclined plane the valve g^4 will be opened. The vacuum-valve and air-valve in this case are operated by the float in practically the same manner as described in connection with Fig. 1, and friction-springs a^6, attached to the wall of the chamber A^2, to press the valve-rods and hold them in either of the two positions in which they may be placed.

In the form of my improved water-elevator shown in Figs. 1 and 2 the operation is as follows: The pipe G being connected with a vacuum-pump, the air is exhausted from the entire series of chambers A, and the pipe H of the lower chamber of the series being inserted in the body of water at the bottom of the shaft or well air-pressure causes the water to rise in the pipe H and enter the compartment B of the first chamber A of the series, and the valve m being closed and the valve r being open, and there being free communication through the slot e between the compartments C and D, the water in the compartment B lifts the valve d and flows into the compartment C, and when the said com-

partment is filled with water it overflows through the slot *e* into the compartment D. As the lower part of the chamber A fills with water the float F rises, and coming into contact with the stem *j* of the valve *g* lifts the valve *g* and allows the water contained by the compartment C to quickly flow into the compartment A, thus causing the float F to rise quickly. The arm *e'*, attached to the valve-operating rod *d'*, being longer than the arm e^2 of the rod d^2, the said arm *e'* is engaged by the float F before the arm e^2 and the vacuum-valve *r* is closed against its seat, in which position it is held by the weight on the valve-arm *s* and by the float. The apertures of the ears attached to the float being elongated and the water continuing to flow into the lower part of the chamber A from the compartment C, the free side of the float continues to rise, thus tipping it slightly and bringing it into engagement with the arm e^2 of the rod d^2, and the said rod by the engagement of the lugs f^2 with the finger *p* of the valve-arm *l* opens the valve *m*, thus establishing communication between the interior of the compartment D and the external air. At this point in the operation the valve *d* closes and water continues to flow into the compartment B, the communication between this compartment and the vacuum-pump not having been broken. The pipe H is connected with the bottom of the chamber A and communicates with the top of the compartment B of the next chamber above, and the air having been exhausted from the next chamber above the water contained in the lower part of the lower chamber is forced by atmospheric pressure upwardly through the pipe H and delivered to the compartment B of the second chamber in the manner already described in connection with the first, when the same series of operations occurs in the second chamber, and as soon as that chamber is filled the vacuum-valve *r* of that chamber is closed and the water contained by the second chamber is elevated to the third. In the first or lower chamber as the water is discharged the float F descends, and when it reaches its lowest point it first strikes the angled end of the rod d^2, forcing the said rod downwardly, and by virtue of its engagement with the lever of the valve *m* closes the said valve and thus shuts off communication with the external air, and the opposite side of the float descends, opening the vacuum-valve, when pressure is equalized in the various chambers, and water again overflows from the compartment B into the compartment C and the operation already described repeats itself.

The operation of the modified form shown in Figs. 3 and 4 is as follows: The upper end of the pipe H' is connected with a pump and the air is exhausted from all of the chambers A', the valve *m'* being closed. The lower end of the pipe H' being immersed in water, water is forced by atmospheric pressure through the pipe H' and delivered to the compartment C'. When this compartment is filled, the water overflows through the slot e^3 into the compartment D' and the float F' rises, being guided by the tube a^3. As the float nears the upper limit of its movement it strikes the stem j' of the valve g^2, opening the said valve and allowing the water to flow from the compartment C' to the compartment D', thus suddenly adding to the volume of the water in the compartment D', causing the float F' to rise farther and open the valve *m'* by its engagement with the lug e^4. The air entering through the tube a^3 forces the water upwardly through the pipe H' into the next chamber above, and when the next chamber above is filled the float opens the air-valve of that chamber and water is carried from that chamber to the third, and so on throughout the series. As the water is discharged from the lower chamber A' the float F' descends, and engaging the angled lower end of the rod d^3 closes the valve *m'*, when the air is again exhausted from the chamber A' and what has already been described is repeated.

It will be noticed that both air and water ascend through the pipe H'. It will also be noticed that the weighted lever *p'* holds the valve *m'* in either of the two positions in which it is placed until the valve-rod is again moved by the float.

In the modification shown in Figs. 5 and 6 the operation is like that described in connection with Fig. 3, except as regards the forked pipe H'. In this case the branch k^3 of the pipe H' is closed by the valve n^3 when the float F' is raised, and the valve n^2 is then opened, so that most of the water passes through the branch k^2; but when the float descends far enough to close the valve n^2 and open the valve n^3 the water remaining in the pipe H' is preserved in a solid column by the ball o^3, which nearly fills the pipe and thus permits of carrying the entire column of water upwardly and discharging it into the next chamber above, and after its upward excursion the ball o^3 returns it to the lowest position by its own gravity. It will thus be seen that the branches k^2 k^3 of the pipe H' are alternately opened and closed as the float rises and falls.

In the modification shown in Fig. 7 the operation is substantially like that of the form shown in Fig. 3.

In the form shown in Fig. 9 the extra supply of water for causing the float to operate quickly during the latter part of its upward travel is carried by the float itself, and when it is discharged into the chamber it not only augments the supply of water which forces the float upwardly, but the discharge of the water lightens the float and increases its buoyant power.

It will be seen that in the modifications shown in Figs. 3 to 7, inclusive, the water which enters the chambers D' and D will have to pass through the whole series and be discharged from the system before a vacuum

can again be established in the lower member of the series and a flow be reëstablished.

By inclosing the float-rods in tubes and employing the tubes as guides for the float the float is kept out of frictional contact with the rods, and positive action is insured.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a water-elevator, a chamber having a float-compartment, and a water-receiving compartment having an overflow discharging into the float-compartment, a valve-operating float placed in the float-compartment, a float-operated valve for controlling communication between the water-receiving compartment and the float-compartment, and air and vacuum valves for controlling the admission and escape of air, substantially as specified.

2. In a water-elevator, a chamber having a float-compartment and a water-receiving compartment having an overflow discharging into the float-compartment, a valve-operating float placed in the float-compartment, a float-operated valve for controlling communication between the water-receiving compartment and the float-compartment, a water-suction pipe, a vacuum-pipe, and a water-reservoir in constant communication with the vacuum-pipe, substantially as specified.

3. In a water-elevator, a compartment chamber in which are provided a float-compartment, a water-receiving compartment provided with an overflow discharging into the float-compartment, a water-reservoir compartment provided with a valved tube opening into the water-receiving compartment, a valve for establishing communication between the float-compartment and water-receiving compartment, vacuum and air valves, and a float and float-rods for operating the valves, substantially as specified.

4. In a water-elevator, the combination, with the air, vacuum and water valves having contact-stems of different lengths, of a float for striking the valve-stems one after the other and operating the valves in succession, whereby the water-valve is opened first, the vacuum-valve is closed, and the air-valve opened in their order, as described.

DETALMO DI BRAZZA SAVORGNAN.

Witnesses:
C. SEDGWICK,
F. W. HANAFORD.